

Distribution and some biological aspects of cephalopods in the North and Central Adriatic

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Abstract

This paper reports data about the distribution of cephalopods caught during trawl surveys carried out in the North and Central Adriatic from 1982 to 2004. Biological notes on some cephalopods are also reported.

Riassunto

Nel corso di 40 campagne di ricerca di pesca a strascico effettuate in Alto e Medio Adriatico, fra il 1982 e il 2004, sono state ritrovate 32 specie di cefalopodi di cui tre molto rare nell'area di studio. In questo lavoro, i dati più recenti vengono utilizzati per aggiornare le informazioni sulla presenza e distribuzione dei cefalopodi meno frequenti o di minore importanza commerciale.

Key words

Cephalopods, Adriatic sea, deep-distribution, trawl-survey.

Introduction

The Adriatic Sea extends for about 800 km from NW to SE; its width ranges from 90 to 220 km. It can be subdivided into three basins.

The northern basin has shallow waters and depths that gently increase southwards reaching 70 m at maximum depth. The central basin reaches the maximum depth in the Pomo (or Jabuka) pit (– 260 m). The southern basin is almost entirely occupied by a fairly deep pit which reaches – 1,223 m. The general circulation is dominated by a cyclonic gyre: the water masses inflow through the Strait of Otranto along the eastern side and outflow along the western side. The north-western Adriatic is characterised by a large freshwater inflow that lowers the salinity and leads to high primary production and high biological productivity. These features, together with the geological history of the basin, trigger the presence of some endemic species (other than cephalopods), mostly euryhaline and of cold water affinity, in the northernmost part of the Adriatic. However, there is no evidence of any isolated population of cephalopods in the North Adriatic Sea (Bello, 1990).

The teuthofauna of the Adriatic Sea includes 45 of the 65 species known from the Mediterranean basin (Bello, 2003). In this work some observations are reported about the presence and distribution of the cephalopod species caught during several trawl surveys carried out in the North and Central Adriatic Sea. Such surveys were accomplished in the framework of the demersal resources evaluation programs: GRUND (from 1982 to 2004) and MEDITS (from 1994 to 2004). Some data about the first years of these surveys have been already published (Casali et al., 1998; Soro & Piccinetti Manfrin, 1989) and are updated here with the results of recent campaigns.

Material and methods

The study area covers the Italian territorial waters and the international waters of the North and Central Adriatic, to the north of the line joining the Gargano promontory (Italy) to Kotor (Montenegro). GRUND surveys were carried out in different seasons up to 1996, afterwards they were carried out only in autumn. The gear used was the *tartana*, a commercial Italian trawl net, with the cod-end mesh size of 40 mm (stretched). Samplings in MEDITS surveys were always accomplished in the summer, using an experimental gear with the mesh cod-end size of 20 mm (stretched).

Hauls were carried out from 10 to 800 m of depth. Catch data in weight were standardised to the surface unit (= 1 km²).

Size is reported as dorsal mantle length (ML), if not otherwise specified.

Results

Thirty-two species of cephalopods were found: 3 of them belong to the order Sepiida, 11 to the order Sepiolida, 10 to the order Teuthida and 8 to the order Octopoda.

In each survey the Octopoda were the predominant fraction, in terms of weight: *Eledone moschata* was the most abundant species in autumn and winter surveys (from 29% to 60% of the total cephalopod catches), whereas *Eledone cirrhosa*, *E. moschata*, and *Illex coindetii* were the most abundant species in spring and summer.

Heteroteuthis dispar, *Histioteuthis bonnellii*, *Octopus macropus*, and *Pteroteuthis tetracirrhus* were no longer collected after 1995 in any survey taken into account in this paper. These species, as well as *I. coindetii*, *E. moschata*, *E. cirrhosa*, *Sepia officinalis*, *Loligo vulgaris*, *Octopus vulgaris*,

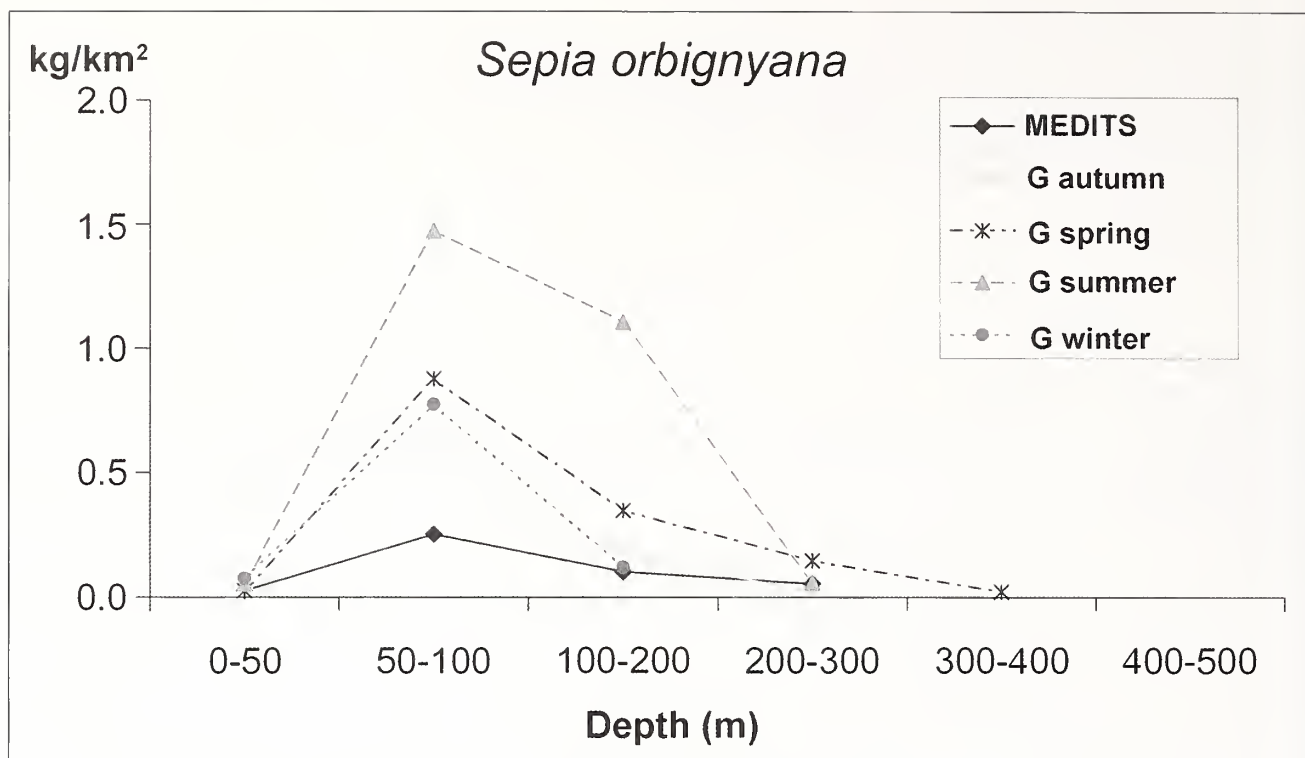


Fig. 1. Biomass index against depth gradient for *Sepia orbignyana* in MEDITS Surveys and in different seasons of GRUND Surveys.

Fig. 1. Indice di biomassa su gradiente di profondità di *Sepia orbignyana* nei survey MEDITS e in diverse stagioni dei survey GRUND.

have been fully discussed previously by Casali et al. (1998) and Soro & Paolini (1994).

Sepiidae

Sepia orbignyana and *Sepia elegans* show a bathymetric range wider than *Sepia officinalis*, which is not found deeper than 100 m.

Sepia orbignyana has been caught from 15 to 450 m of depth, although it is more abundant from 50 to 100 m in all seasons (Fig. 1). An increase of catches up to 50 m of depth, along the coastal areas and in the area to the north of the Po delta, is recorded in the autumn.

In every season, *S. elegans* is more abundant up to 100 m of depth and its abundance decreases quickly beyond this depth; occasional catches are recorded till 440 m (Fig. 2). Unlike prior assumptions (Casali et al., 1998), new data allow us to suppose that, in the surveyed area, *S. elegans* does not migrate seasonally, although this phenomenon has been observed in other areas (Relini et al., 1999).

In both species, mature males and females occur throughout the year, suggesting a long, almost continuous, spawning period, with males reaching maturity at a smaller size than females (Relini et al., 1999). In *S. orbignyana*, mature males were observed from the size of 38 mm on and females from 40 mm on. In *S. elegans* the smallest mature sizes were 29 mm in males and 31 mm in females. In the Italian seas, the maximum reported size for *S. orbignyana* is 96 mm in females and 93 mm in males (Jereb & Ragonese, 1991; Belcari & Sartor, 1993). In this study the largest collected female was 106 mm, largest males did not exceed 88 mm. The smallest collected

size for both sexes is 12 mm. The size for *S. elegans* in the studied area ranges from 20 to 80 mm in females and from 21 to 75 mm in males.

Sepiolidae

Sepietta oweniana is the species more frequently caught, followed by *Rondeletiola minor*, *Sepiola robusta*, and *Rossia macrosoma*.

The latest data corroborate the distribution reported by Guescin and Manfrin (1986) for the species of the genus *Sepietta* (Fig. 3).

Sepietta obscura, which prefers shallow waters and sandy bottoms, was mainly caught in the northernmost area of the Adriatic from 30 to 50 m whereas only 10 specimens were caught deeper than 100 m.

Sepietta oweniana and *Sepietta neglecta* were mainly found in the middle-southern part of the study area. *Sepietta neglecta* was occasionally caught (110 specimens) between 37 and 340 m, that is the same depth range in which it was fished in the Strait of Sicily (Jereb & Di Stefano, 1995).

Sepietta oweniana is common in the whole area across a wide bathymetric range from 15 to 450 m, with catches increasing with depth up to 200 m. Females showed larger size than males, as reported from the Ionian Sea and Aegean Sea (D'Onghia et al., 1995). MLs ranged from 20 to 32 mm in males and from 12 to 45 in females. Mature individuals were found throughout the year, with larger percentages in the summer, thus suggesting a peak in the reproductive activity in this season (Relini et al., 1999).

Species belonging to the genus *Sepiola* were more often

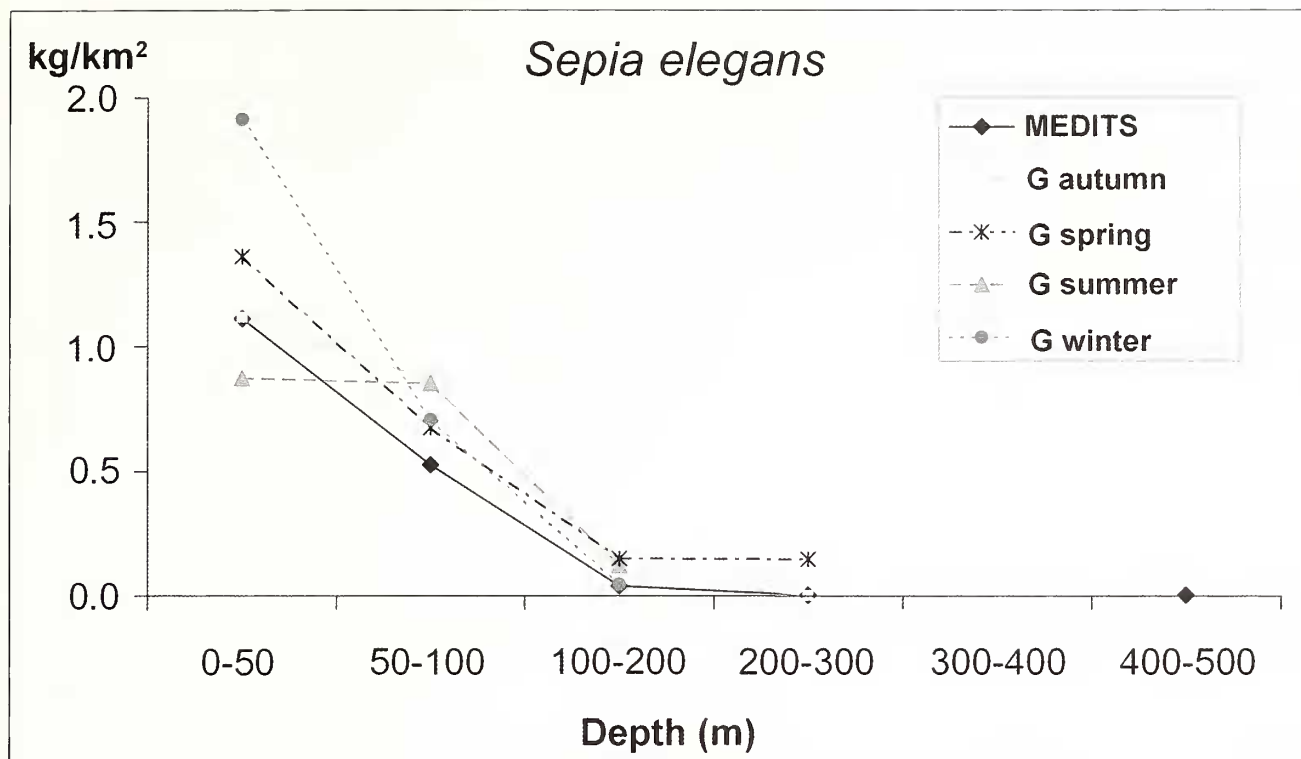


Fig. 2. Biomass index against depth gradient for *Sepia elegans* in MEDITS Surveys and in different seasons of GRUND Surveys.

Fig. 2. Indice di biomassa su gradiente di profondità di *Sepia elegans* nei survey MEDITS e in diverse stagioni dei survey GRUND.

caught in the area north of Pescara, deeper than 200 m and along the coasts (Fig. 4). *Sepiola affinis* was occasionally caught in the area between Ancona and Pescara from 20 to 100 m (166 speci-

mens); in the autumn two individuals were caught at 120 m and two males were caught in the Pomo Pit at 220 m, an exceptional depth for this benthic littoral species that usually lives at 25-30 m of depth.

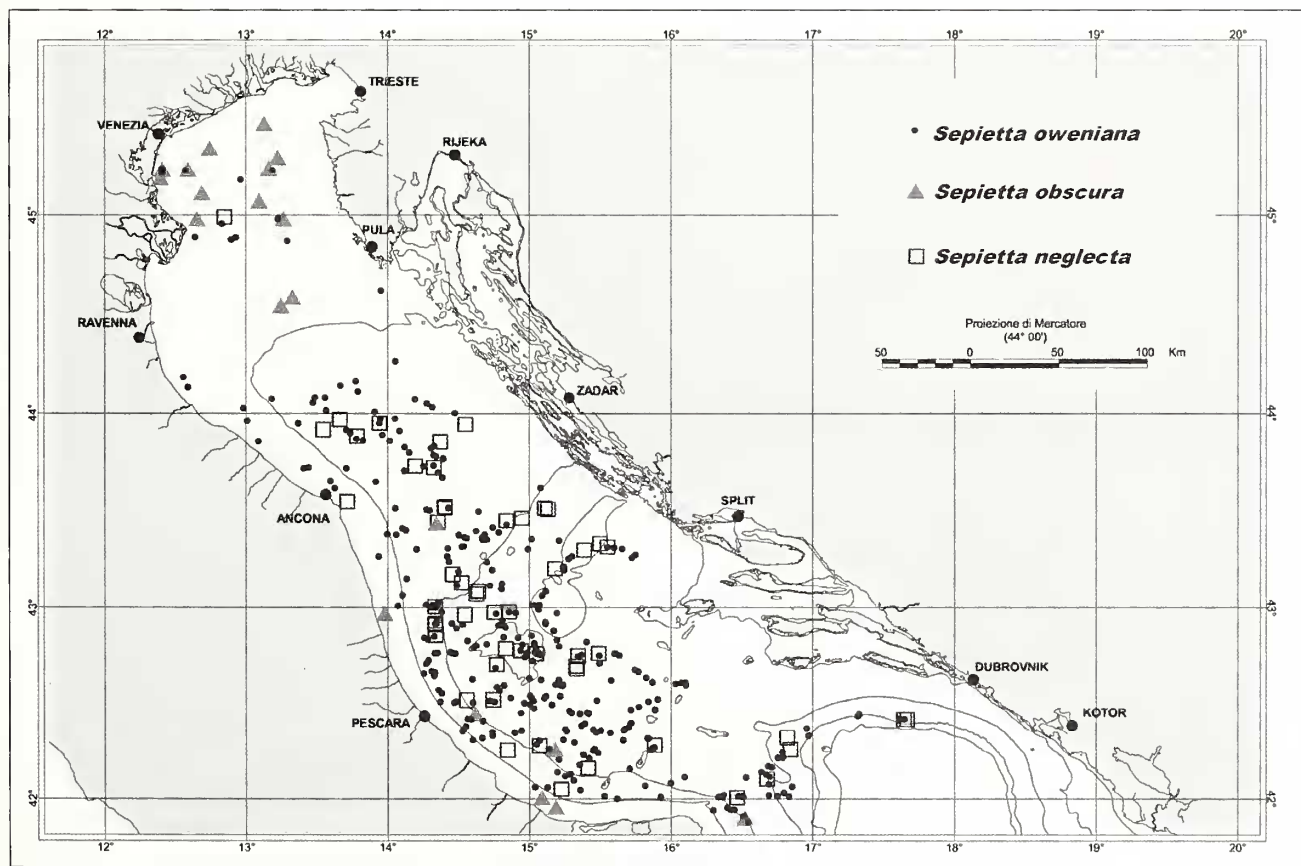


Fig. 3. Distribution area of the genus *Sepietta*.

Fig. 3. Distribuzione del genere *Sepietta*.

Species	North Adriatic		Middle Adriatic						Depth	
	10-50	51-100	10-50	51-100	100-200	201-300	301-500	501-800	min.	max.
Order SEPIIDA										
Family SEPIIDAE										
<i>Sepia officinalis</i> Linnaeus, 1758	+	+	+	+	+	-	-	-	10	143
<i>Sepia orbignyana</i> Férussac, 1826	+	+	+	+	+	+	+	-	15	439
<i>Sepia elegans</i> de Blainville, 1827	+	+	+	+	+	+	+	-	11	444
Order SEPIOLIDA										
Family SEPIOLIDAE										
<i>Sepiola rondeletii</i> Naef, 1912	+	+	-	-	-	-	-	-	21	75
<i>Sepiola intermedia</i> Naef, 1912	+	+	+	+	+	-	-	-	10	114
<i>Sepiola ligulata</i> Naef, 1912	+	+	+	+	+	+	-	-	23	201
<i>Sepiola robusta</i> Naef, 1912	+	+	-	+	+	+	-	-	15	229
<i>Sepiola affinis</i> Naef, 1912	+	+	+	+	+	+	-	-	19	220
<i>Sepietta oweniana</i> (d'Orbigny, 1841)	+	+	+	+	+	+	+	-	14	444
<i>Sepietta neglecta</i> Naef, 1916	+	+	+	+	+	+	+	-	37	334
<i>Sepietta obscura</i> Naef, 1916	+	+	+	+	+	-	-	-	25	113
<i>Rondeletiola minor</i> (Naef, 1912)	+	+	+	+	+	+	+	+	23	733
<i>Heteroteuthis dispar</i> (Rüppell, 1844)	-	-	-	-	-	-	+	-	327	450
<i>Rossia macrosoma</i> (Delle Chiaje, 1830)	-	-	-	+	+	+	+	+	82	742
Order TEUTHOIDEA										
Family LOLIGINIDAE										
<i>Loligo vulgaris</i> Lamarck, 1798	+	+	+	+	+	+	+	-	10	412
<i>Loligo forbesii</i> Streenstrup, 1856	+	-	-	+	+	+	-	-	19	260
<i>Alloteuthis media</i> (Linnaeus, 1758)	+	+	+	+	+	+	+	-	10	334
Family ENOPLOTEUTHIADE										
<i>Abralia veranyi</i> (Rüppell, 1844)	-	-	-	-	+	+	+	+	107	750
Family ONYCHOTEUTHIDAE										
<i>Onychoteuthis banksii</i> (Leach, 1817)	-	-	-	-	-	-	+	+	335	830
Family HISTIOTEUTHIDAE										
<i>Histioteuthis bonnellii</i> (Férussac, 1835)	-	-	-	-	+	-	-	+	167	581
<i>Histioteuthis reversa</i> (Verrill, 1880)	-	-	-	-	-	-	-	+	564	830
Family OMMASTREPHIDAE										
<i>Illex coindetii</i> (Verany, 1839)	+	+	+	+	+	+	+	+	12	733
<i>Todaropsis eblanae</i> (Ball, 1841)	-	-	+	+	+	+	+	+	19	733
<i>Todarodes sagittatus</i> (Lamarck, 1798)	-	+	-	+	+	+	+	+	77	623
Order OCTOPODA										
Family OCTOPODIDAE										
<i>Octopus vulgaris</i> Cuvier, 1797	+	+	+	+	+	+	-	-	17	396
<i>Octopus macropus</i> Risso, 1826	-	-	-	-	+	-	-	-	107	336
<i>Octopus salutii</i> Verany, 1851	-	-	+	+	+	+	+	-	29	463
<i>Octopus defilippi</i> Verany, 1851	-	-	-	-	+	+	-	-	93	260
<i>Scaevargus unicolor</i> (Delle Chiaje, 1830)	+	+	+	+	+	+	+	-	33	344
<i>Pteroctopus tetracirrlus</i> (Delle Chiaje, 1830)	-	-	-	-	+	+	-	-	110	239
<i>Eledone moschata</i> (Lamarck, 1798)	+	+	+	+	+	-	-	-	10	163
<i>Eledone cirrhosa</i> (Lamarck, 1798)	-	+	+	+	+	+	+	-	17	462

Tab. 1. List of cephalopods caught in the North and Central Adriatic during demersal trawl surveys carried out from 1982 to 2004.

Tab. 1. Lista dei cefalopodi rinvenuti in Alto e Medio Adriatico nell'ambito di trawl surveys dal 1982 al 2004.

Sepiola intermedia was caught only in the spring and in the summer from 10 to 120 m of depth (112 individuals), mainly along coastal areas. *Sepiola ligulata* was caught between 20 and 200 m of depth (50 individuals), with catches increasing with depth. *Sepiola robusta* was regularly found in the northernmost part of the studied area, up to 100 m of depth (292 indi-

viduals); in the spring and in the summer 17 specimens were found up to 230 m of depth. Only four specimens of *Sepiola rondeletii* were caught: two individuals in the summer of 1999 off Pesaro (depth: 21 m) and two in the summer of 2000 off Ancona (75 m). *Rondeletiola minor* is mainly distributed in the middle part of the Adriatic basin (Fig. 5). Previously, it was doc-

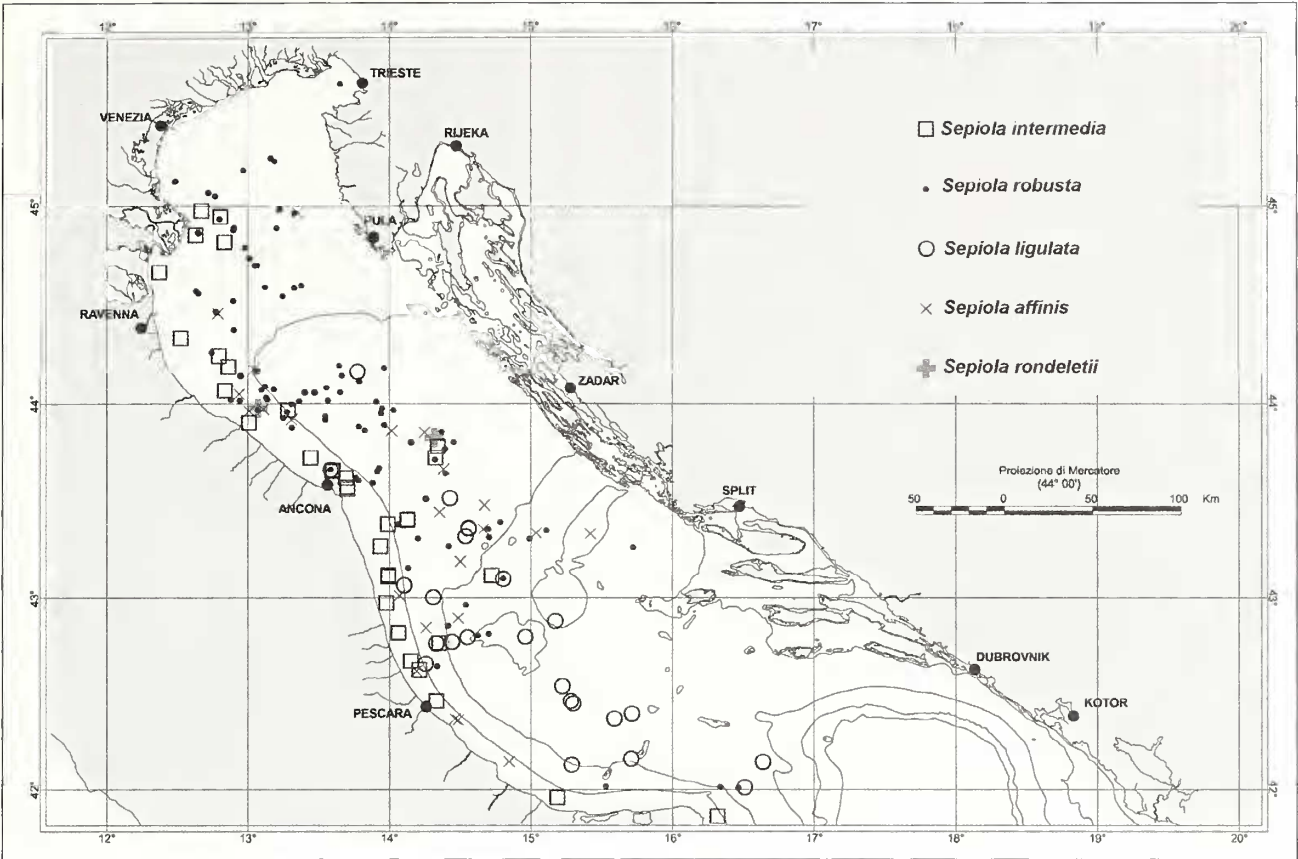


Fig. 4. Distribution area of the genus *Sepioida*.

Fig. 4. Distribuzione del genere *Sepioida*.

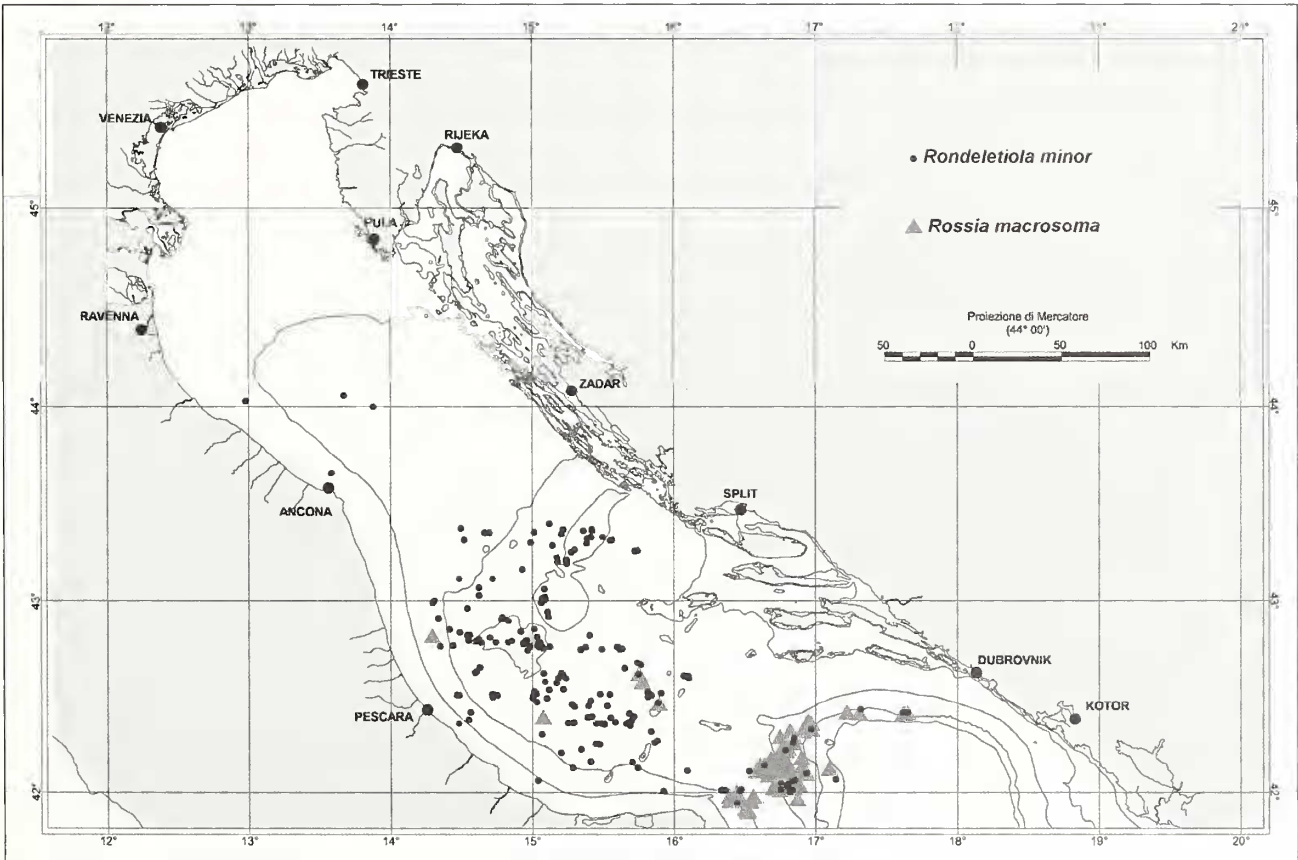


Fig. 5. Distribution area of *Rondeletiola minor* and *Rossia macrosoma*.

Fig. 5. Distribuzione di *Rondeletiola minor* e *Rossia macrosoma*.

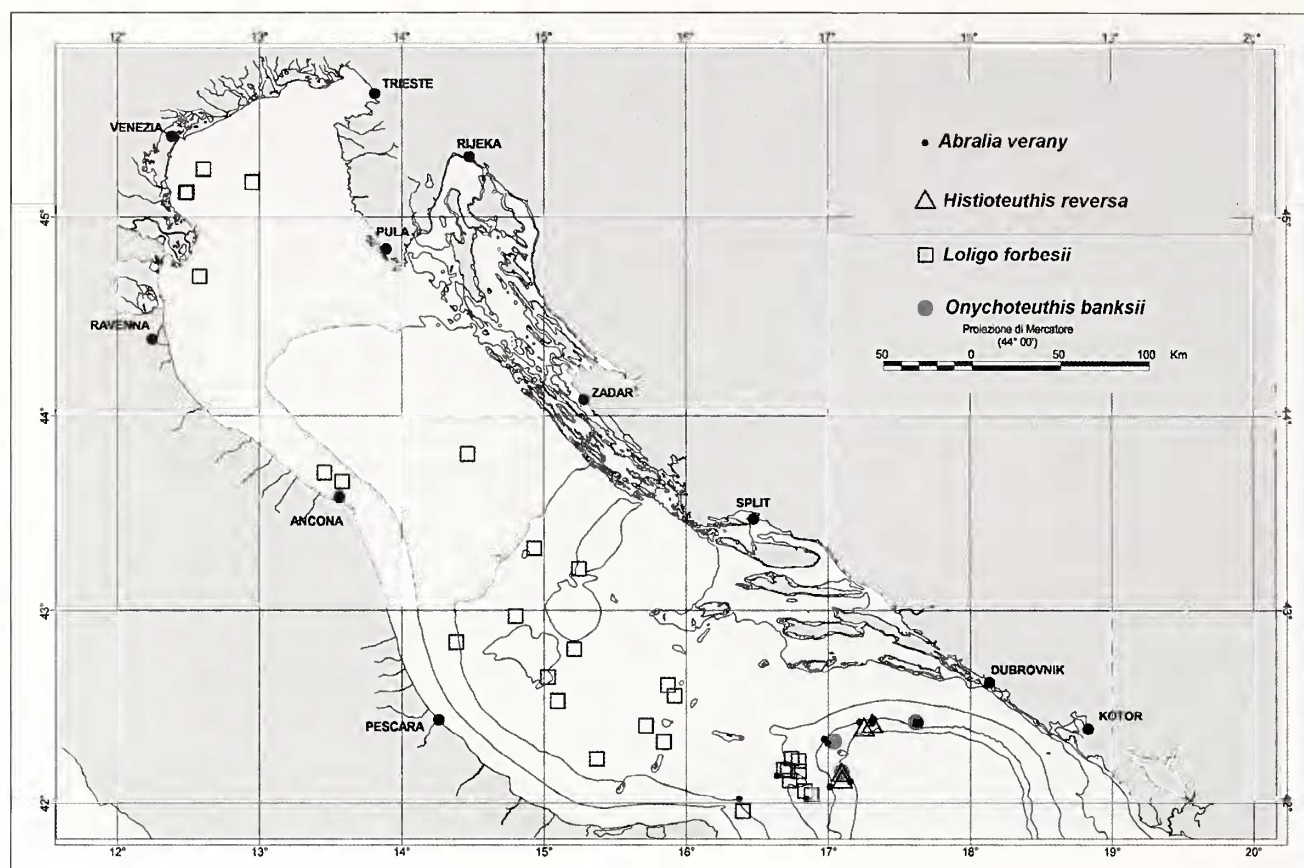


Fig. 6. Distribution area of *Loligo forbesii*, *Abralia verany*, *Histioteuthis reversa*, and *Onychoteuthis banksii*.

Fig. 6. Distribuzione di *Loligo forbesii*, *Abralia verany*, *Histioteuthis reversa* e *Onychoteuthis banksii*.

umented up to 150-200 m of depth (Bello, 1990; Guescini & Manfrin, 1986). Recent data point out that this species is common from 150 to 300 m of depth, but four specimens were caught also at depth from 20 to 80 m to the north of Ancona and four specimens beyond 450 m in the area in front of the Gargano promontory. It was always caught together with *S. oweniana*, as observed in other Mediterranean areas (Mannini & Volpi, 1989; Jereb & Di Stefano, 1995).

Rossia macrosoma is mainly distributed in the area in front of the Gargano, from 100 to 450 m of depth (192 specimens); three specimens were netted at 82 m off Giulianova (Fig. 5). As it was observed in the Aegean and in the Ionian Seas (D'Onghia et al., 1995), in the northern and central Adriatic as well mature individuals were found throughout all seasons. The smallest mature female measured 47 mm and the smallest male 31 mm. Mantle length ranged from 26 to 58 mm in males, from 30 mm on in females. The latter were found to reach larger sizes than the former, as observed in the Aegean Sea (D'Onghia et al, 1994).

Loliginidae

Loligo forbesii is an uncommon species in the surveyed area. It prefers depths over 50 m (Relini et al., 1999) but 13 specimens were caught at shallower depths in the northern Adriatic, especially in the spring and in the summer (Fig. 6); the same depth of capture was already documented in the southern Adriatic Sea (Bello, 1990).

Alloteuthis media is widely found in the Middle and North Adriatic from 50 to 200 m of depth with occasional catches down to 500 m. In all seasons *A. media* is more concentrated to the depth of 50 m and its abundance decreases with depth. Unlike the North Tyrrhenian Sea (Mannini & Volpi, 1989), seasonal migrations towards the coastal waters were not observed during the spawning period. The largest abundance indices were reported in the autumn survey (Soro & Piccinetti-Manfrin, 1989).

Ommastrephidae

Todarodes sagittatus and *Todaropsis eblanae* share a similar distribution (Fig. 7). *Todarodes sagittatus* was rarely caught, mainly in the central Adriatic from 90 to 610 m of depth, although nine individuals were caught at 70 m; in all, 54 individuals were caught. Catches increased with depth, from 0.08 kg/km², in the 50-100 m stratum, to 1.57 kg/km², in the 500-800 m stratum.

Todaropsis eblanae was fished only in the central Adriatic (1,014 specimens), from 20 to 750 m of depth, often together with *Illex coindetii*, as also found by Gamulin-Brida & Ilijanić (1972). It showed the largest abundance from 200 to 300 m of depth. Biological data of *Todaropsis eblanae* point out a wide reproductive period: in the Adriatic Sea individuals are found at different maturity stages all year though, as in the Tyrrhenian Sea (Favilla, 1996). Mature specimens were found throughout the year although they were more abundant in the spring and autumn. This is in agreement with Mangold-Wirz

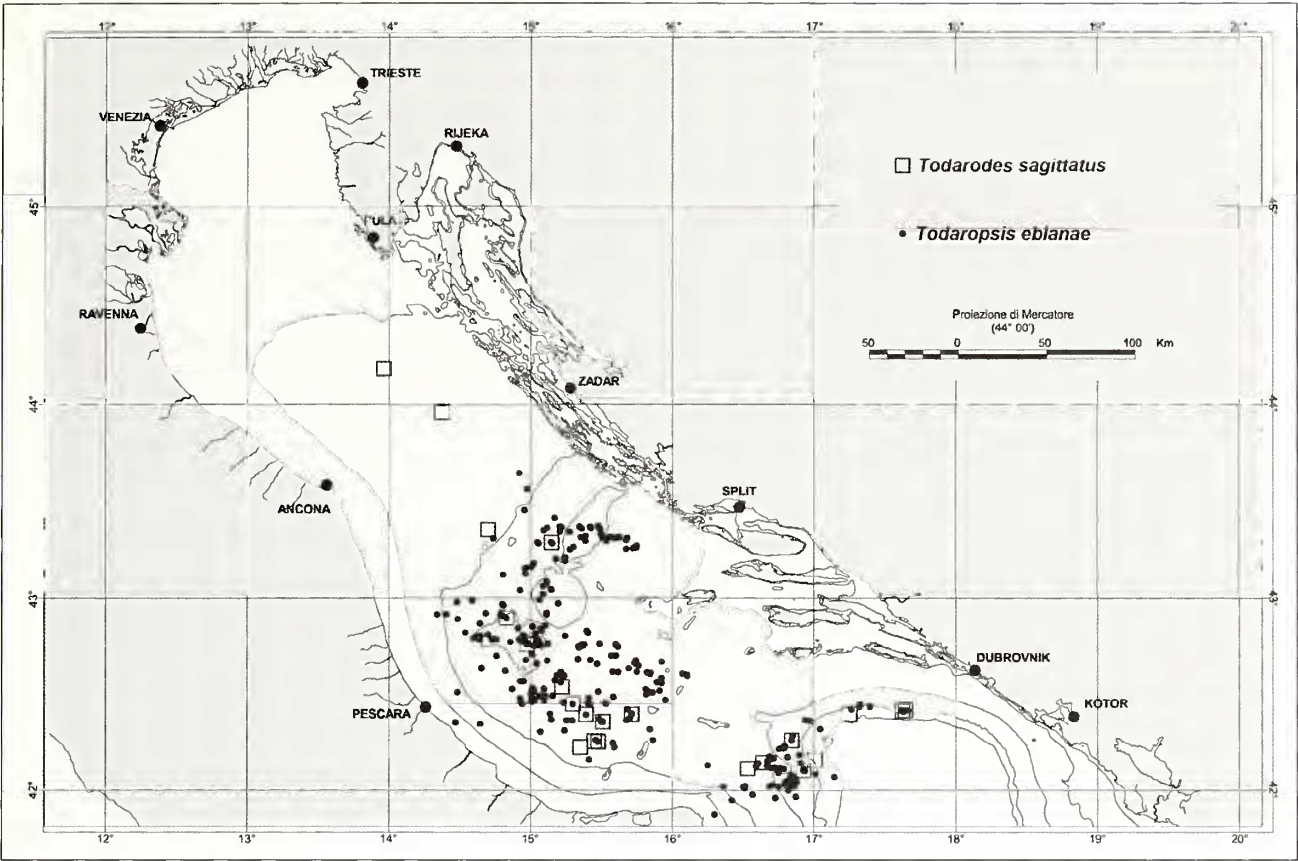


Fig. 7. Distribution area of *Todarodes sagittatus* and *Todaropsis eblanae*.

Fig. 7. Distribuzione di *Todarodes sagittatus* e *Todaropsis eblanae*.

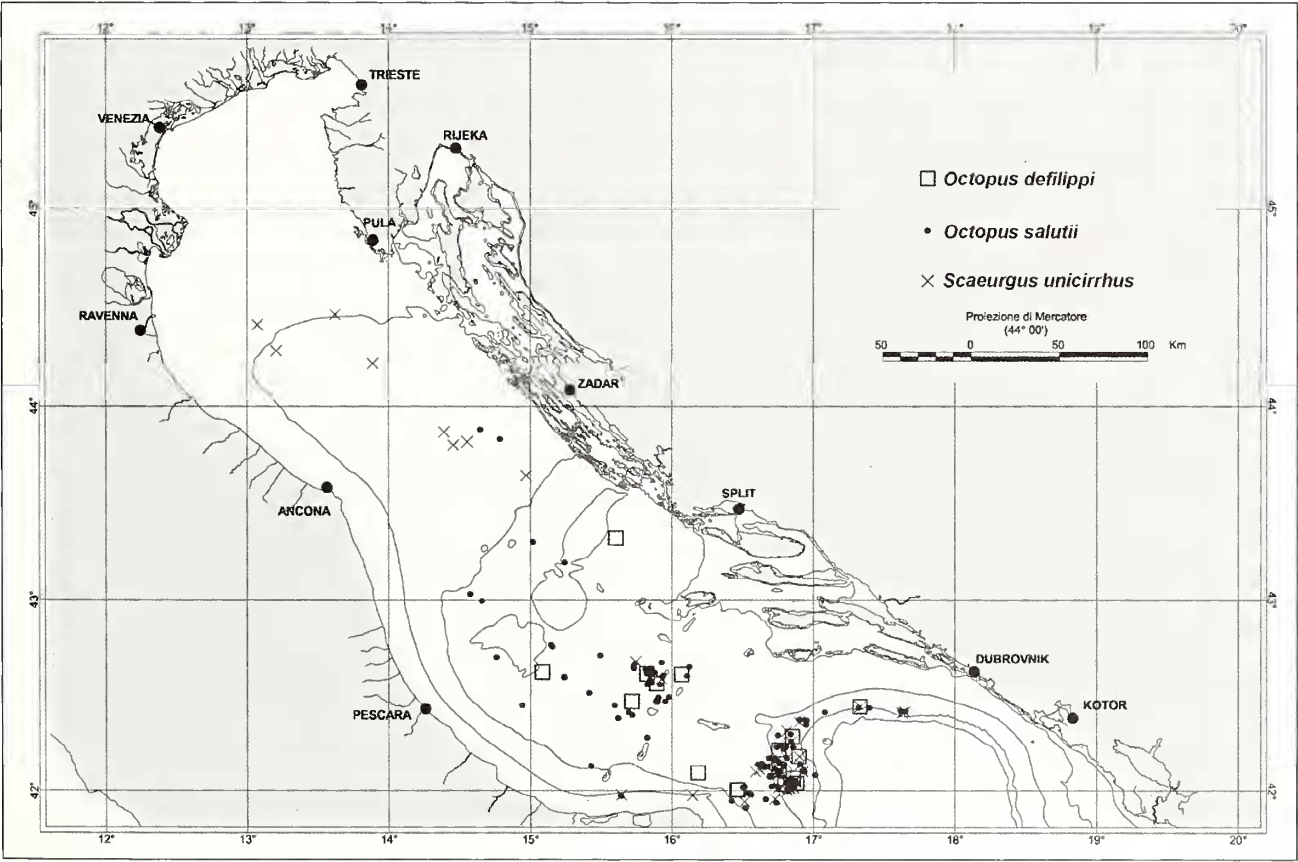


Fig. 8. Distribution area of *Octopus defilippi*, *Octopus salutii* and *Scaergus unicirrhus*.

Fig. 8. Distribuzione di *Octopus defilippi*, *Octopus salutii* e *Scaergus unicirrhus*.

(1963) who documented the reproductive period from March to November. Males reach maturity at a smaller ML than females (Relini et al., 1999). In the study area the minimum size for a mature male was 100 mm and for a mature female 110 mm. Females attained larger sizes than males, in agreement with Relini et al. (1999). The maximum size observed was 185 mm in females and 140 mm in males.

Octopodidae

Herein only data about *Octopus salutii*, *Octopus defilippi*, and *Scaevurgus uuicirrhus* are reported; for the other species of the order Octopoda, refer to Casali et al. (1998) and Soro & Paolini (1994).

These species inhabit sandy and muddy bottoms (Mangold-Wirz, 1963; Boletzky, 1977). The most abundant catches were recorded in the area in front of the Gargano promontory (Fig. 8), probably because of suitable depths and type of bottom.

Among these species, *O. salutii* showed the widest bathymetric range: 279 specimens were caught from 50 to 450 m of depth; in the summer of 2004 an individual was caught at 30 m. Catches increased with depth.

In other areas of the Mediterranean *S. uuicirrhus* is occasionally found, usually deeper than 100 m (Mannini & Volpi, 1989; Bello, 1990; Pastorelli et al., 1998). In the study area it was collected in the bathymetric range from 50 to 400 m (102 specimens); some individuals were also caught in the northern part of the Adriatic.

Octopus defilippi showed the lowest abundance; it was rarely caught (33 specimens) and only in the southern area of the Middle Adriatic at depths from 110 to 260 m.

Rare species

Abralia verauy is a pelagic species which was caught only in summer off the Gargano promontory. The largest catches were recorded from 300 to 400 m of depth; however it was found in a wider bathymetric range, from 100 to 750 m (Fig. 6).

Only 12 individuals of *Onychoteuthis bauskii* were caught in three summer surveys at depths from 330 to 830 m (Fig. 6).

Histioteuthis reversa was caught in the summer. The four netted individuals were found between 550 and 830 m of depth (Fig. 6).

Discussion

The distribution of cephalopods depends on many factors including their evolutionary history, the geographical history and the environmental conditions (Boletzky, 1999).

The bathymetric range of the species caught in the trawl surveys in the central and northern Adriatic agrees with and supports the data reported for other areas of the Mediterranean (D'Onghia et al., 1995; Mannini & Volpi, 1989; Pastorelli et al., 1998).

Only few species show anomalous occurrences. Some specimens of *Octopus salutii* were fished at depths shallower than 50 m, *Todarodes sagittatus* at 70 m, whereas two specimens of *Sepiella affinis*, which is considered a shallow water species, were found deeper than 200 m. In the study area, little biological information is available about rarely caught species as well as low commercial value ones, compared to fishery targeted cephalopods. This study makes us suppose a broad reproductive period for some species such as *Todaropsis eblanae*, *Sepia elegans*, *Sepia orbignyana*, *Sepietta oweniana*, and *Rossia macrosoma*. We expect to widen the knowledge of many aspects of the ecology and reproductive biology of all these species with the data to be collected in the next surveys.

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